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Taxonomic Notes on *Acmaeopleura balssi* Shen, 1932 and *A. toriumii* Takeda, 1974 (Crustacea, Brachyura, Grapsidae) from Japanese Waters

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Abstract The rare grapsid crab, *Acmaeopleura balssi* Shen, 1932, is redescribed based on Japanese specimens, which conform closely to the descriptions of Chinese specimens, except the presence of dense setae at the base of the gape of both fingers. The species is differentiated from the close congener, *A. toriumii* Takeda, 1974, from Japan and Hong Kong by its larger adult size (largest in the genus attaining 17 mm carapace width), more rounded carapace shape with narrower frontorbital width, distinctively crossed tips of fingers, third maxillipeds with less produced distal inner margin of merus, and shape of the male suborbital crest.
Key words: Grapsidae, *Acmaeopleura*, West Pacific, Japan.

The Indo-West Pacific crab genus *Acmaeopleura* Stimpson, 1858 (Grapsidae: Varuninae) comprises five species, *A. parvula* Stimpson, 1858, *A. rotunda* Rathbun, 1909, *A. balssi* Shen, 1932, *A. depressa* Sakai, 1965 and *A. toriumii* Takeda, 1974 (Takeda, 1974; Davie, 1992). Itani (in press) recognizes one further undescribed species that differs from the known species by the conformation of the male suborbital crest and the shape of the carapace among other characters.

Shen (1932) described *Acmaeopleura balssi* based on a male specimen from the Shantung Peninsula, North China, and later he made the complementary description based on another male and one female (Shen, 1948). Sakai (1939) wrongly identified *A. balssi* from Sagami Bay, but in 1965 he described these specimens as a new species, *A. depressa*. Distribution of *A. balssi* in Japan has been previously confirmed from Toyama Bay and the Seto Inland Sea (Sakai, 1965) and from the Soya Strait (Takeda and Miyauchi, 1992) (Fig. 1). Away from China and Japan, female specimens of *A. balssi* were collected from Madagascar (Crosnier, 1965) and the Arabian Sea (Ghani and Tirmizi, 1991). In both cases, however, the identification is doubtful, because the specimens recorded were females which lack the well developed, distinctive suborbital crest of the male, one of the most reliable characters to distinguish the species in this genus. Thus, the occurrence of this species outside of China is confirmed only from Japan. The opportunity is taken here to document infraspecific variation in *A. balssi* as exhibited by the Japanese specimens on comparison with its close congener, *A. toriumii*.

Measurements (in mm) given are of carapace length (CL) followed by carapace width (CW). The abbreviations of the museums and universi-

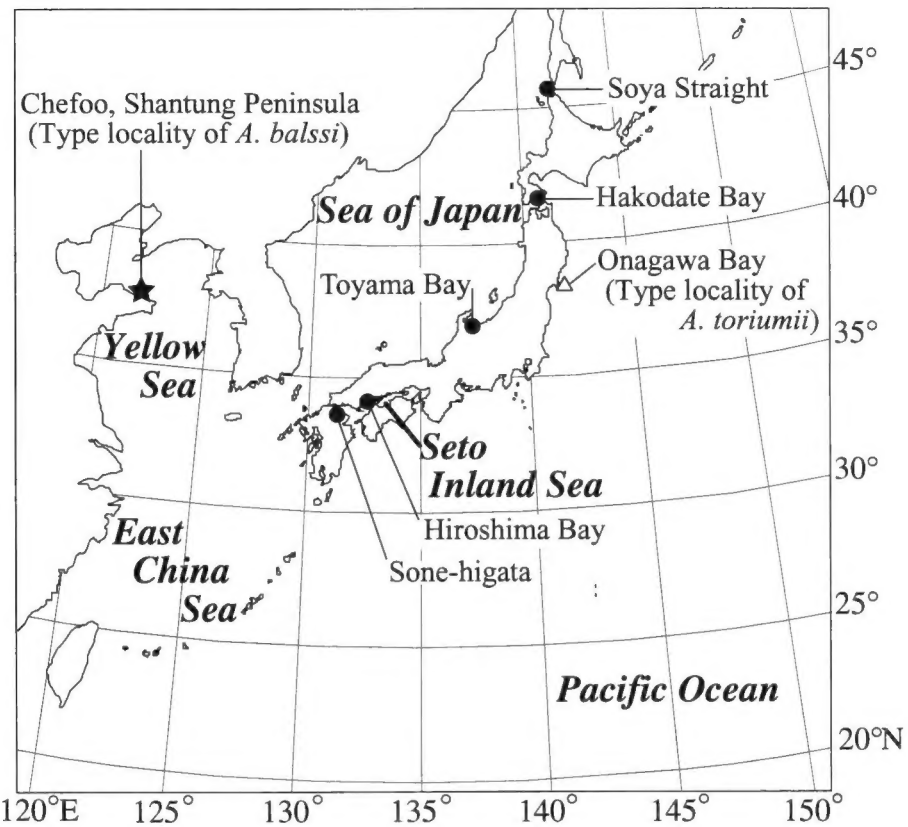

Fig. 1. Location of the type locality (★) and distribution (●) of *Acmaeopleura balssi* in Japan). Specimens examined in this study are from the Soya Strait, Hakodate Bay, and Sone-higata. Type locality of *A. toriumii* is also shown (△).

ties are as follows. NSMT=National Science Museum, Tokyo; HUMZ=Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University; OMNH=Osaka Museum of Natural History, KUZ=Kyoto University Museum.

Family Grapsidae

Genus ***Acmaeopleura*** Stimpson, 1858

Acmaeopleura balssi Shen, 1932

[Japanese name: O-hime-akaisogani]

(Figs. 2, 3)

Acmaeopleura balssi Shen 1932, p. 155, figs. 98, 100, pl. 6 figs. 1, 2; Shen, 1948, p. 114, fig. 5; Sakai, 1965, p. 197, fig. 26b; 1976, p. 643, pl. 220 fig. 1; Dai & Yang, 1991, p. 518, fig. 265 (2, 3); Takeda & Miyauchi, 1992, p. 149.

[Not] *Acmaeopleura balssi* — Sakai, 1939, p. 663, fig. 116 (=*A. depressa* Sakai, 1965).

[?] *Acmaeopleura balssi* — Crosnier, 1965, p. 44, figs. 60–62, pl. 6 fig. 3; Ghani & Tirmizi, 1991, p. 93, fig. 1.

Acmaeopleura toriumii — Komai *et al.*, 1992, p. 202.

Material examined. Soya Strait, off Wakkanai, Hokkaido, Japan, dredged (depth unknown), coll. T. Miyauchi, 4 males (13.6×17.2; 13.2×17.0; 12.2×16.2; 10.9×13.2) and 1 female (11.7×14.4), NSMT-Cr 11261; Hakodate Bay, Hokkaido, Japan, in the gut of *Physiculus japonicus* Hilgendorf, 1 female (7.1×8.5), HUMZ-C 1564; Sone-higata tidal flat, Kitakyushu, Fukuoka, Japan, intertidal, Aug 1998, coll. T. Karasawa, 1 male (8.2×9.8), OMNH-Ar 5023; same locality as OMNH-Ar 5023, intertidal, 17 Apr. 1999, coll. G. Itani, 2 males (5.6×6.4; 3.9×4.6)

and 1 female (5.0×6.0), KUZ-Z3.

Description. Carapace broader than long, broadest medially; dorsal surface convex, sparsely punctuate; regions not apparent with transverse gastro-cardiac groove. Carapace margins marked with granulated ridge. Epimeron detected in dorsal view. Front truncate, about one fourth carapace width; dorsal surface weakly bilobed, with shallow median groove. Orbit semicircular; ventral inner orbital tooth blunt, slightly curved inward. Ocular peduncle stout, granulated. Frontorbital width a little more than half carapace width.

In males, suborbital crest composed of two contiguous elongate crests and an outer small crest; inner crest low, granulated; middle crest prominent, protruding from low inner crest (Fig. 3b). In a large female (CL 117×CW 14.4 mm) from the Soya Strait, suborbital crest composed of two long inner crests and small outer tubercles; inner crests low, weakly granulated (Fig. 3b′).

Third maxillipeds (Fig. 3c) broad, but not completely closing buccal cavity; surface punctate. Ischium broader than long; inner margin convex, ridged; anterior, posterior and outer margins concave. Merus broader than long; inner and outer margins convex, ridged; anterior margin concave. Palp elongate, reaching beyond anterior margin of ischium; dactylus longest, with very long distal setae reaching beyond anterior ridge of sternum, lying in longitudinal sternal sulcus when folded.

Chelipeds equal, granulated, punctate. Palm inflated; outer surface with a transverse ridge. Both fingers stout, weakly curved inward distally, but tip of movable finger more curved, so as to cross at tips (see Fig. 3d, e, f); cutting edges with blunt teeth; gape narrow; basal part of cutting edge of immovable finger with tufts of short setae.

Ambulatory legs moderately long; dorsal and ventral margins minutely granulated, except dactyli. Each dactylus nearly straight. Leg segment proportions of a male (CL 12.2×CW 16.2 mm) from the Soya Strait are as follows. Third ambulatory leg: merus length ca. 3.4 times width, and ca. 0.74 times CL; propodus length ca. 2.3 times width, and ca. 0.35 times CL; dactylus length ca. 6.4 times width, and ca. 0.31 times CL. Fourth ambulatory leg: merus length ca. 3.2 times width, and ca. 0.58 times CL; propodus length ca. 1.8 times width, and ca. 0.27 times CL; dactylus length ca. 5.6 times width, and ca. 0.27 times CL.

Sternum (Fig. 3i, j) relatively broad, punctate; shallow longitudinal sulcus medially below mouth frame, extending to abdominal insertion. Male abdomen elongate triangular (Fig. 3k, l). Female abdomen round, telson very wide (Fig. 3m); in small female (CL 5.0×CW 6.0 mm) from Sone-higata, abdomen is juvenile triangular form.

First pleopod of male reaching anterior end of 5th sternite, with small bilobed chitinous process subapically (Fig. 3n, o).

Color in life. Typically light buff; specimens from the Sone-higata tidal flat with red or brown blotches symmetrically disposed.

Remarks. Japanese specimens are readily assigned to *Acmaeopleura balssi* due to the form of the male suborbital crest. The only notable difference from Chinese specimens, as described by Shen (1932, 1948) and Dai and Yang (1991), is in the presence of dense setae in the gape of the fingers. Shen (1932, 1948) did not mention the presence or absence of setae, but the figure in Shen (1932) shows that there are short sparse setae in the gape. Dai and Yang (1991) stated "without hairs at the base [of fingers]". However, the exact conformity of our Japanese specimens with those from China in the shape of the carapace, male suborbital crest, third maxilliped and ambulatory legs, suggests that the presence of setae in the chela gape may be simply due to geographic or infraspecific variation. Our specimens also agree with the brief description of *A. balssi* by Sakai (1965) based on the specimens from Hiroshima Bay in the Seto Inland Sea and from Toyama Bay in the Sea of Japan.

In the smaller specimens (CW less than 6.4 mm) from Sone-higata, the front is more pro-

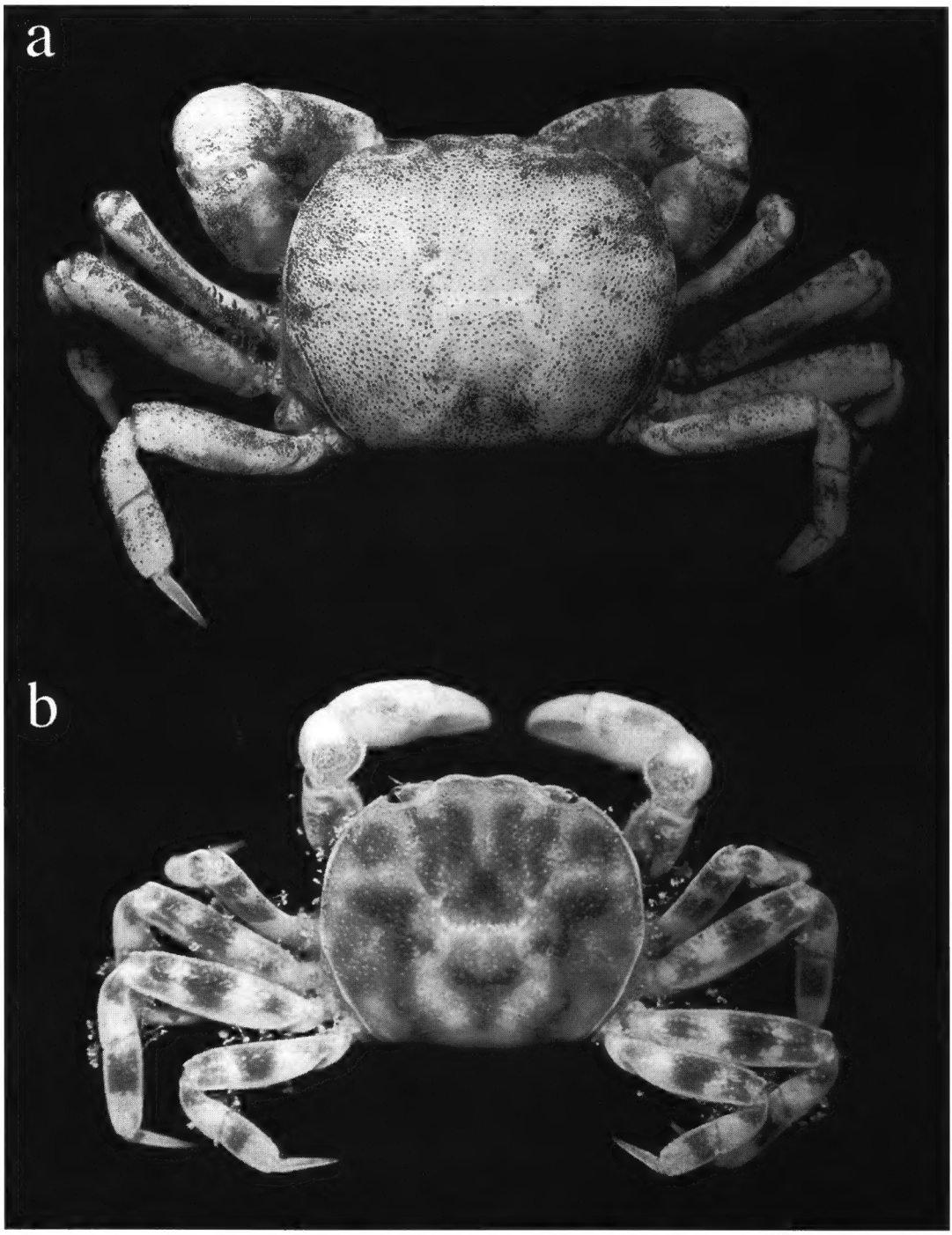

Fig. 2. *Acmaeopleura balssi* Shen from Sone-higata. a, male (CW 9.8 mm). b, male (CW 6.4 mm) fixed in ethanol.

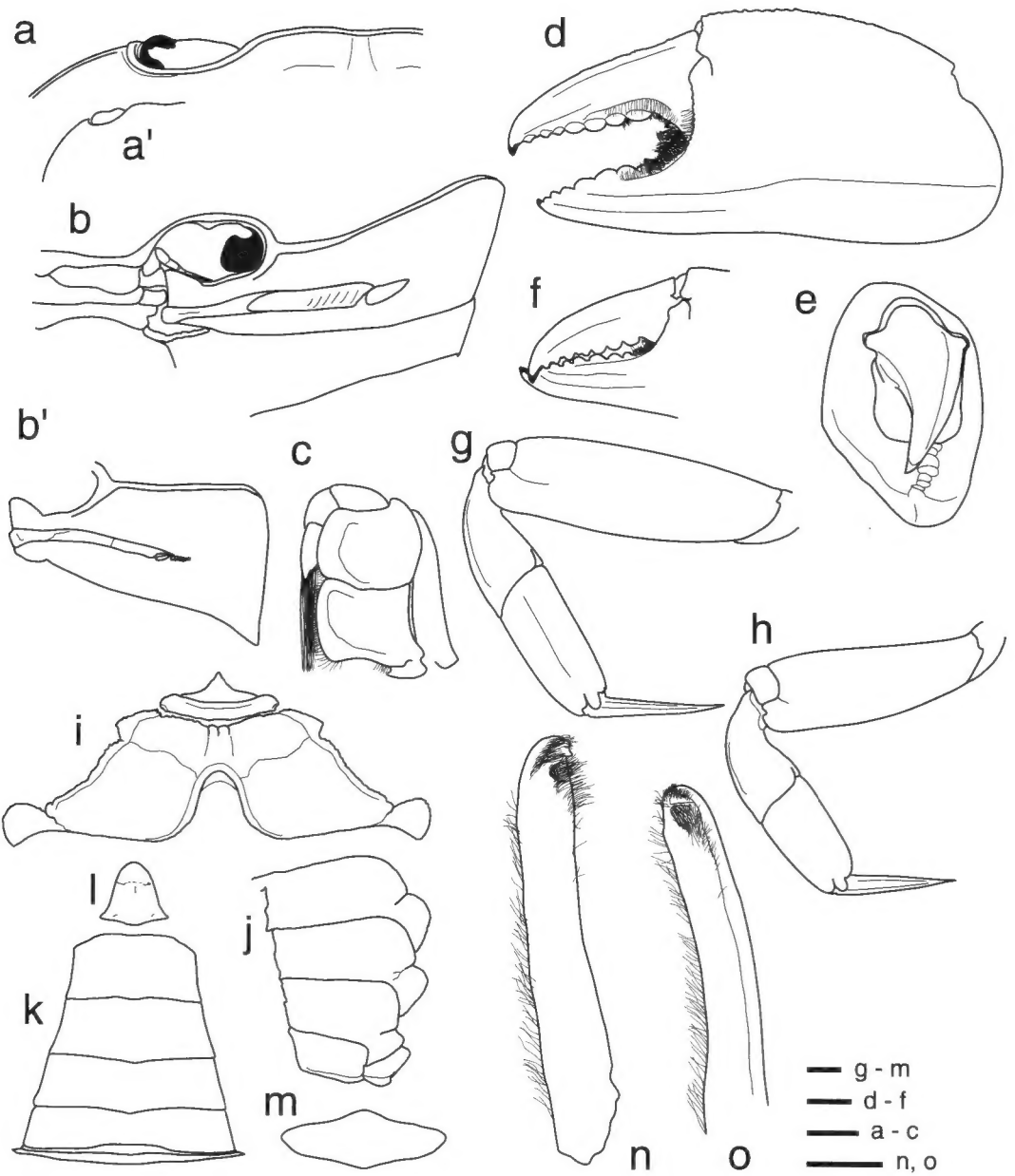

Fig. 3. *Acmaeopleura balssi* Shen. a–e, g–l, n, o, NSMT-Cr 11261, male (CW 16.2 mm). b′, f, m, NSMT-Cr 11261, female (CW 14.4 mm). a′, KUZ-Z3, male (CW 6.4 mm). a and b, frontal region in dorsal and frontal view, respectively; c, left third maxilliped; d and e, left cheliped in outer and distal view, respectively; f, right cheliped in inner view; g and h, left third and fourth ambulatory leg, respectively; i and j, anterior and posterior sternum, respectively; k, male abdomen; l and m, male and female telson, respectively; n and o, male first pleopod. Scales are 1 mm.

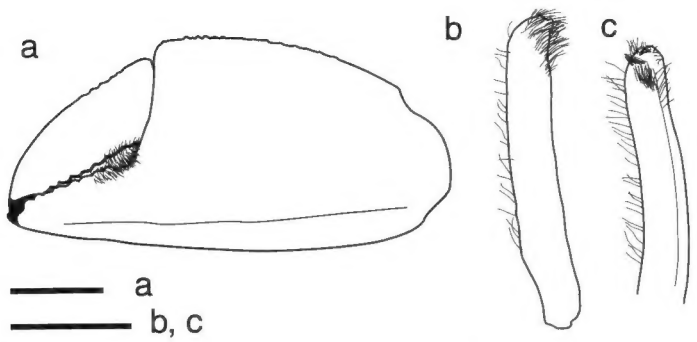

Fig. 4. *Acmaeopleura toriumii* Takeda, male (CW 8.4 mm) from Sone-higata. a, left cheliped in outer view; b and c, male first pleopod. Scales are 1 mm.

truding (Fig. 3a′), the chelipeds are more slender, and the gape between the fingers is narrower. As a larger specimen (CW 9.8 mm) from Sone-higata is the same as those from the Soya Strait, and matches the description of the Chinese material, these variations can presumably be attributed to ontogenetic change. The shape of the suborbital crest also changes ontogenetically. In a small male (CW 4.6 mm) and a female (CW 6.0 mm) from Sone-higata, inner crests are too low to be detected, and granulation on the crests cannot be distinguished from the outer small crest or tubercles.

Acmaeopleura cf. *balssi* described by Crosnier (1965) from Madagascar differs from Chinese and Japanese specimens in that the dactylus of the third maxilliped is shorter, the inner distal part of the ischium of the third maxlliped is not projecting, and the merus of the ambulatory legs is shorter. *Acmaeopleura balssi* described by Ghani and Tirmizi (1991) from the Arabian Sea also differs from Chinese and Japanese specimens in that the dactylus of the third maxilliped is shorter, the setae on the palp are shorter, and the tips of the dactyli of the cheliped and walking legs are extremely curved inward.

Acmaeopleura toriumii Takeda, 1974

[Japanese name: Toriumi-akaisomodoki]

(Fig. 4)

Acmaeopleura toriumii Takeda 1974, p. 17, figs. 2, 3; Marumura, 1994, p. 65, fig. 2; Davie, 1992, p. 351; Sakai, 2000, p. 1158, fig. 1i, j; Takeda et al., 2000, pp. 138, 141.

[Not] *Acmaeopleura toriumii* — Komai *et al.*, 1992, p. 202 (=*A. balssi* Shen 1932).

Material examined. Type specimens (NSMT-Cr 973-975) from Onagawa Bay, Miyagi, Japan, were reexamined for comparison; Miyako Bay, Iwate, Japan, 10–15 m deep, 1 Apr 1987, coll. T. Komai, 1 male (4.6×5.2), HUMZ-C 65; Sone-higata tidal flat, Kitakyushu, Fukuoka, Japan, intertidal, Nov 1997, coll. G. Itani, 24 males (3.5×4.1–6.9×8.4) and 16 females (3.8×4.4–5.6×6.6), KUZ-Z4.

Remarks. The suborbital crest of females is composed of numerous small tubercles, less conspicuous than those of males. Small specimens typically have 1) more protruding front, 2) proportionally larger ratio of frontorbital width to carapace width, 3) more slender chelipeds, lacking a gape between both fingers, and 4) less conspicuous setae at the base of the fingers. Sakai (2000) noted, in the specimens from Yoshinogawa River, Tokushima, that the setae at the base of the immovable finger are scarcely visible, though Takeda (1974) noted a tuft of soft setae in the type specimens. This difference is presumably due to the individual variation.

In the following lines differences between this species and *Acmaeopleura balssi* is discussed.

Differences between *Acmaeopleura balssi* and *A. toriumii*

Acmaeopleura balssi is morphologically similar to *A. toriumii*, with the differences in the adult size (larger in *A. balssi*), the frontorbital width (narrower in *A. balssi*), the setae in the gape of the chelae (absent or sparse in *A. balssi*, present in *A. toriumii*), and the shape of male suborbital crest (two elongate crests and one tubercle in *A. balssi*, nine tubercles in *A. toriumii*) (Takeda, 1974). In this study, however, we found that the setae are also present in the chela gape in several populations of *A. balssi*, and thus this character is polymorphic and not useful for discriminating the two species. However, another cheliped character, not before mentioned, does help to separate the two species. In *A. balssi* the tip of the dactylus is curved more inward such that the cheliped fingers are obviously crossed apically, whereas in *A. toriumii* the tips of the fingers typically meet, or cross only slightly at the very tip. Additionally, the chitinous cusps at the finger tips are smaller in *A. balssi*.

The shape of the third maxilliped is similar in that the palps bear extremely long setae. In *A. balssi*, however, the dactylus is longer, the inner-distal projection of the merus is less conspicuous, and the inner-proximal projection of the ischium is also less conspicuous. In addition, the third maxillipeds do not close the buccal cavity completely in *A. balssi*, whereas they do close it completely in *A. toriumii*.

In males, the shape of the suborbital crest clearly discriminates the two species. The shape of the pleopods also differs; *A. balssi* has a larger chitinous process at the tip, and the setae on the outer margin are denser than in *A. toriumii*.

Adult size differs greatly between the two species. Carapace width is 11.8 mm in the holotype of *A. balssi* from the Shantung Peninsula, northern China (Shen, 1932), and reaches as large as 17 mm in the largest specimens from Toyama Bay and the Soya Strait (Sakai, 1965; this study). In contrast, *A. toriumii* is a smaller species: carapace width of the holotype (from Onagawa Bay, Miyagi Pref., northern Japan) is 4.8 mm (Takeda, 1974), and the largest specimens so far found, from Sone-higata and Yamaguchi Bay in the Seto Inland Sea, attain only 8 mm (this study; Itani, in press). In *A. balssi*, a female of 6.0 mm CW still has a juvenile abdomen shape, and males of similar size have the immature slender chelae. In contrast, *A. toriumii* is morphologically adult at the similar size. As for other species in the genus, *A. parvula* reaches 14 mm carapace width (Fukui, 1988; Itani, 2000), and the largest *A. depressa* found is only 7 mm CW (Sakai, 1939). *Acmaeopleura rotunda* is known only from a juvenile specimen. Thus, *Acmaeopleura balssi* is the largest species in the genus.

It is important to note, when comparing two species of such different sizes, that allometric change can affect proportions and shape of characters. The proportion of frontorbital width to carapace width is about half or more in *A. balssi*, but two thirds or more in *A. toriumii*. However, this proportion is negatively allometric, and higher in the smaller specimens. In the smallest specimen of *A. balssi* (CW 4.6 mm), the proportion is ca. 0.68 and not so different from that of *A. toriumii*. Similarly, the space between the third maxillipeds of both sides is narrower in the smaller specimens of *A. balssi*.

The ecology of the two species is also probably different. *Acmaeopleura toriumii* is a cohabitant of a thalassinidean shrimp *Upogebia major*. It does not make its own burrow, or live buried under the surface of sediment (Itani, in press). Other authors have also collected this species from sediment with abundant burrows of *Upogebia* shrimps and other invertebrates (Davie, 1992; Sakai, 2000). Conversely, *A. balssi* is thought to associate with annelids (Sakai, 1965, 1976), although information regarding this relationship was based only on three specimens collected from the Ujina coast, Hiroshima Bay in the Seto Inland Sea, which has since been reclaimed. In the present study, the specimens from Sone-higata were collected from sediment with abundant burrows of thalassinidean shrimps and an echi-

urid *Urechis unicinctus*, but any definite association could not be confirmed. The specimens from China, Toyama Bay and the Soya Strait were collected by dredging and thus no information on symbiotic relationships could be obtained. Considering the large body size reached by *A. balssi*, it seems possible that it may be free-living rather than a burrow cohabitant at least in some populations.

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